

Season - dependent and source-influenced aerosol on HMO TIKSI, Russian Arctic

Olga Popovicheva

A. Makshtas

K. Eleftheriadis, N.C.S.R. Demokritos

T. Uttal

Moscow State University

Arctic Antarctic Research Institute

International Hydrometeorological Observatory

Tiksi was build 2010 and joined IASOA



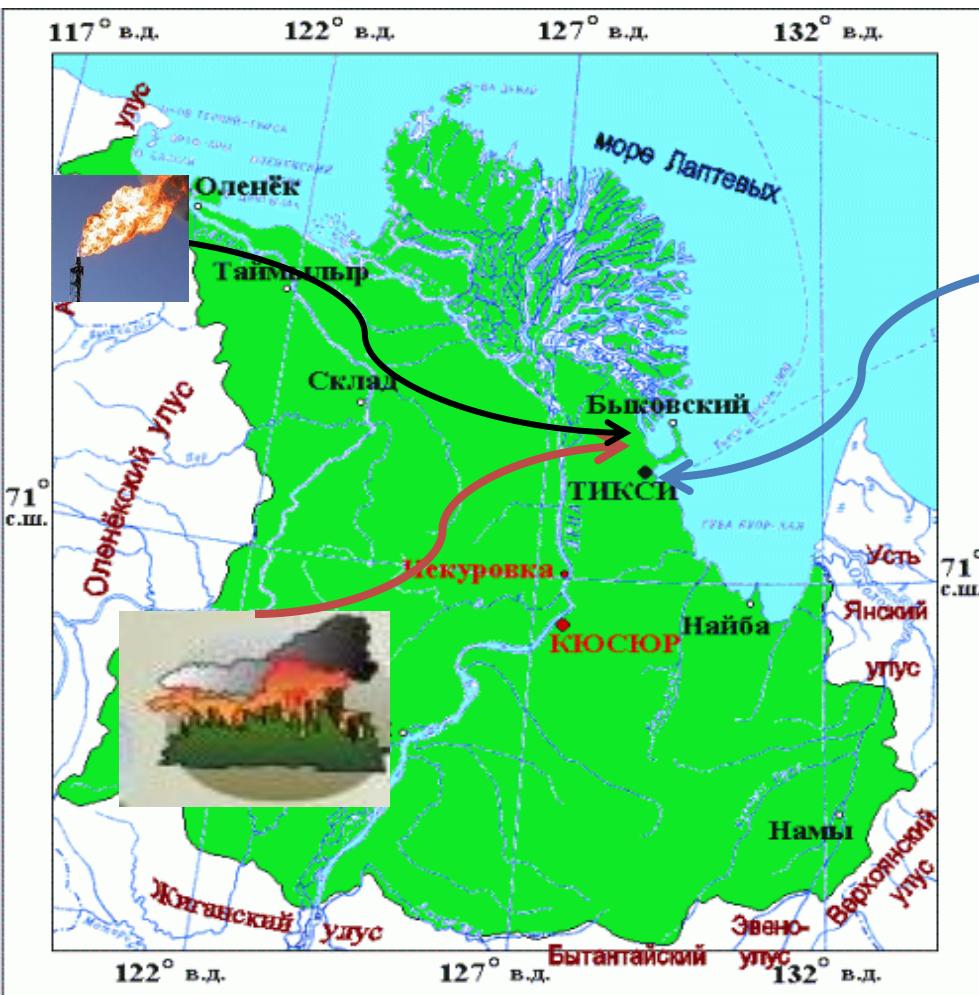
coast of Laptev Sea ($71^{\circ}36'N$; $128^{\circ}53'E$)

Observatory Tiksi

single and unique Arctic station in Russia

on-line aerosol measurements

joint with meteorological observations

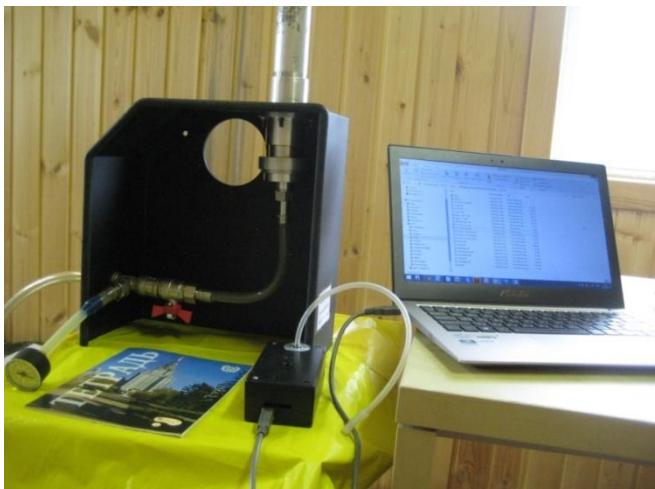


Pavilion of Clean Air Facilities

Sources of pollution ?

- Local from 5 km Tiksi:
 - local heating station on rare oil,
 - diesel stations
 - waste burning.
- from long-term transport:
 - Siberian industrial centers
 - wildfires

TSP Sampling system was installed in September 2014



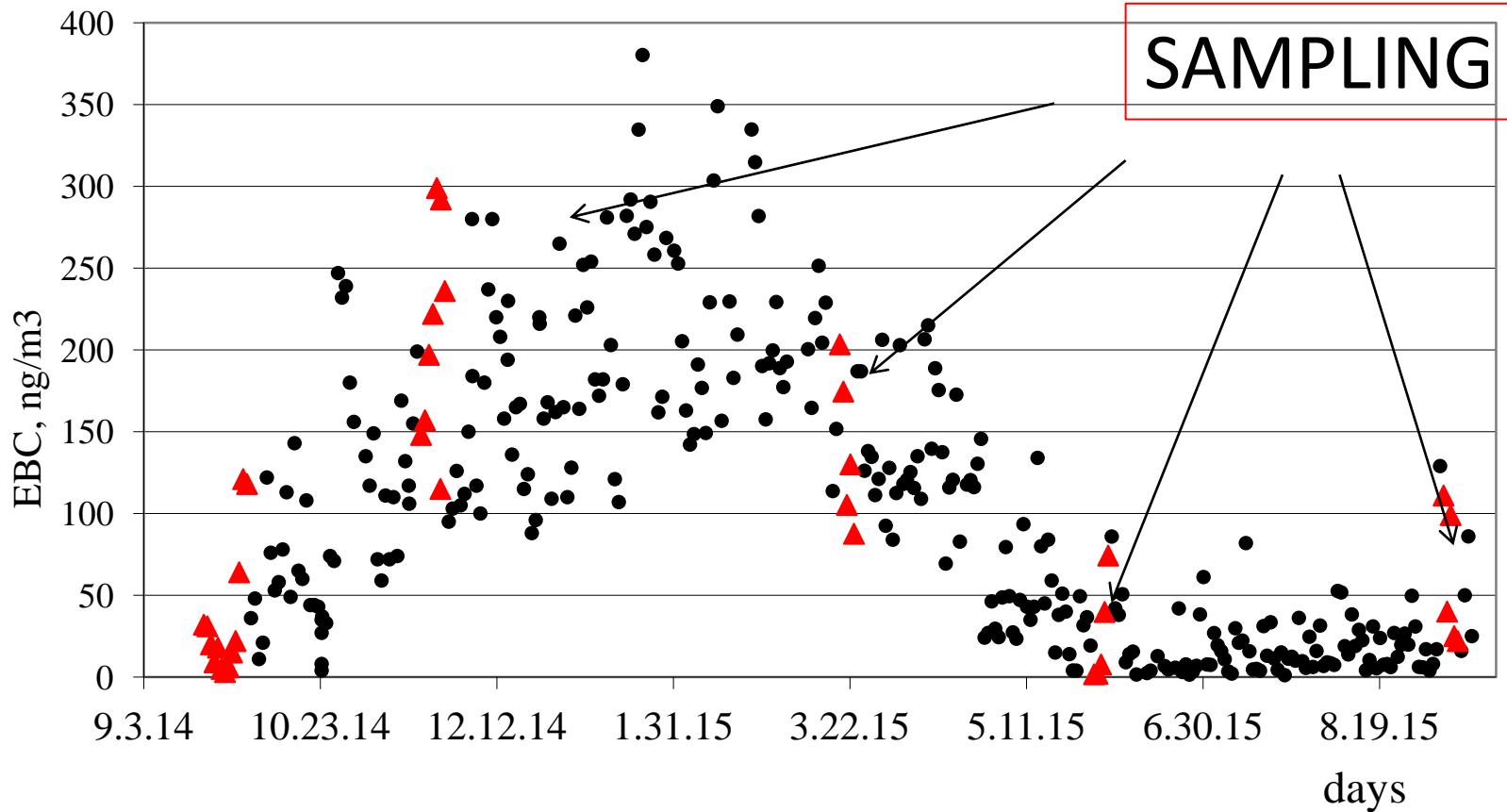
TSP



PM0.24-10



BC season trend and sampling 2014-2015

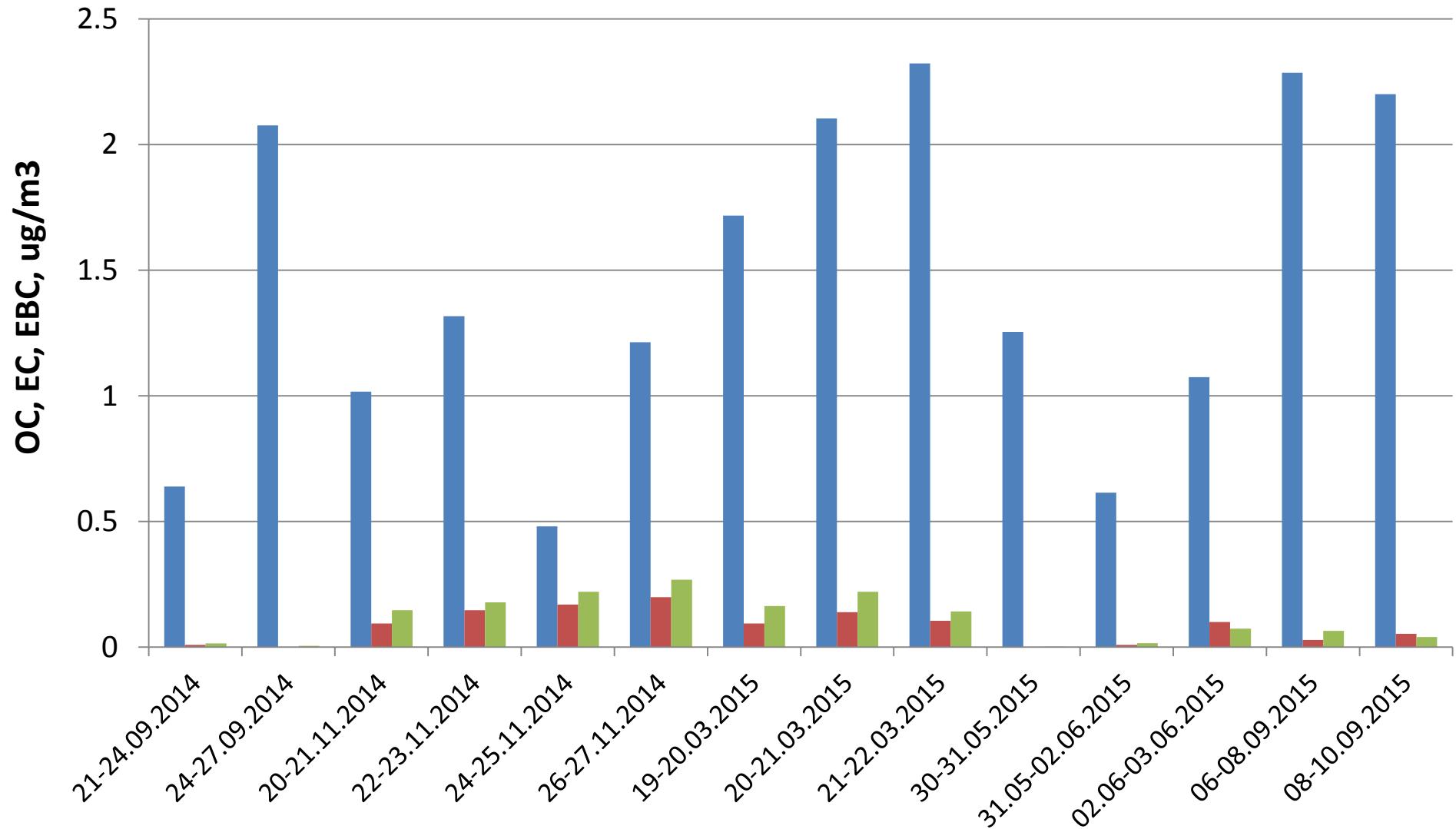


Typical trend for arctic stations (Stone et al, 2014) :
maximum EBC in winter and transition period in autumn and spring

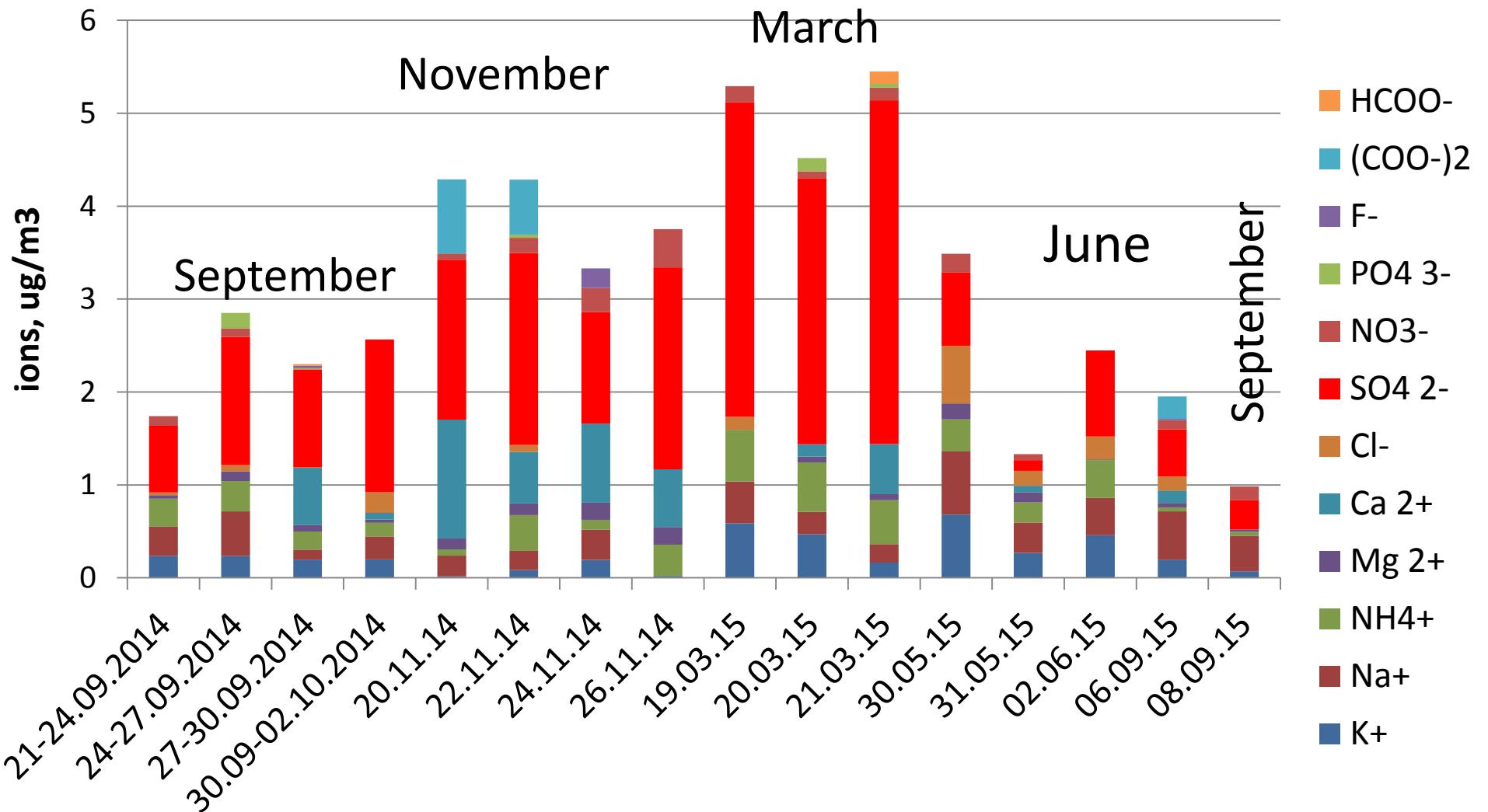
In sampling periods of 2014-2015

EBC and EC well correlate

OC high concentration

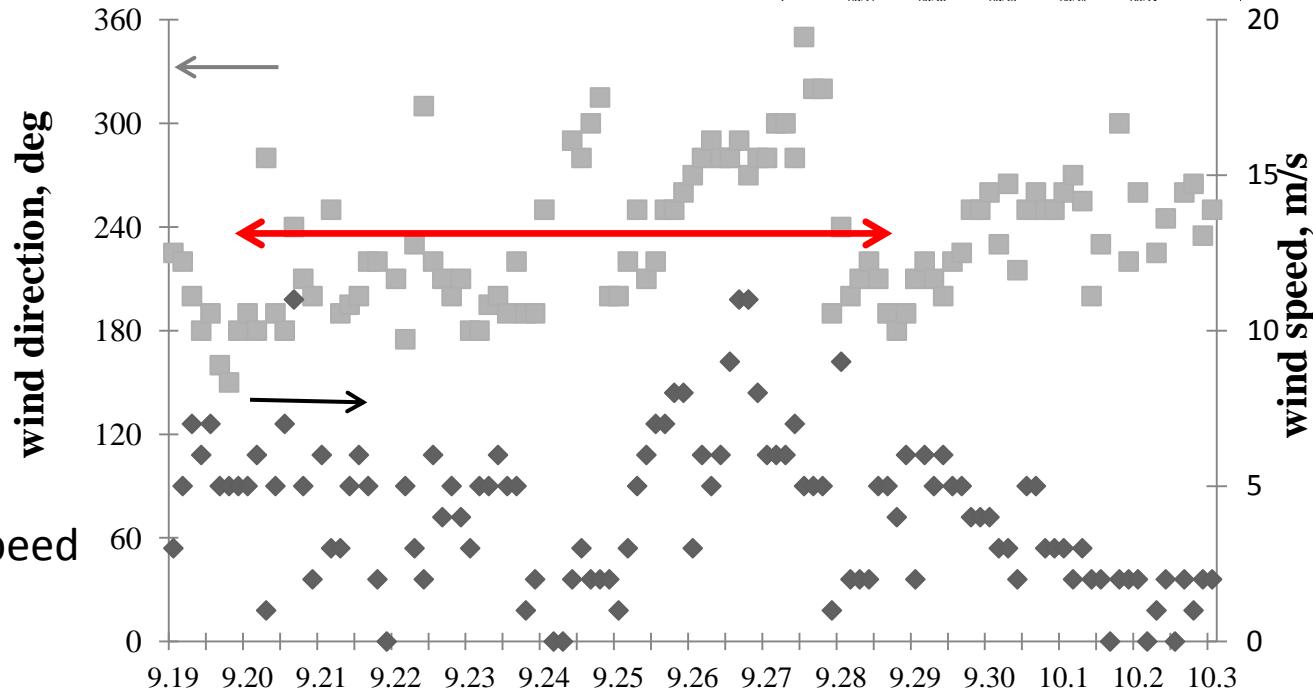
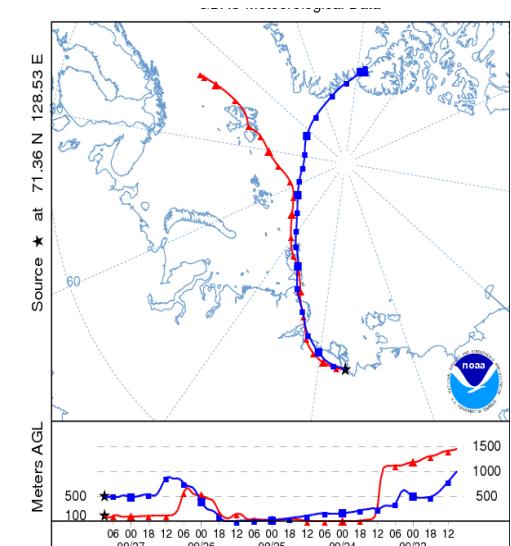
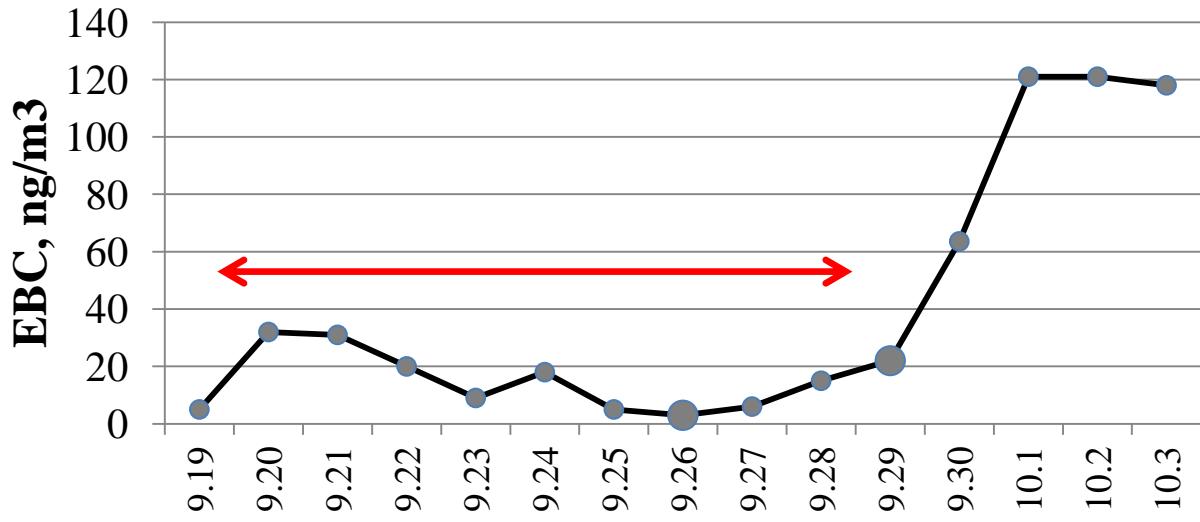


Ions, typical season trend for arctic stations with higher concentration in autumn



High level of SO_4^{2-}

September 2014 – days of natural BC background



Various wind direction and speed

Background aerosol in September

1 μ m

sinp msu

Mag = 7.80 K X

BC background environment

27 September 2014

T = -2C, wind direction southwest 280 °

Individual particle analyses, SEM/EDX

Aerosol grouping

Na-rich
32,5%

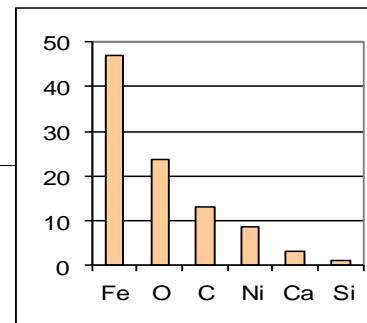
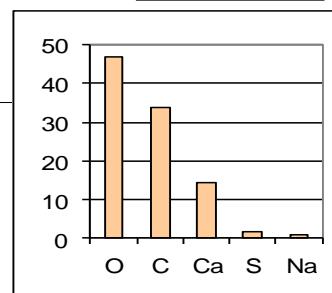
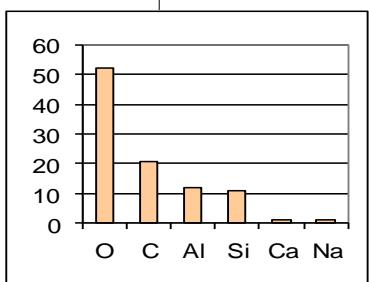
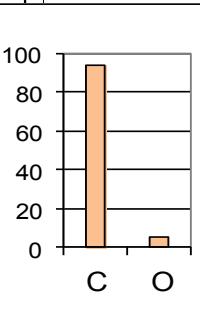
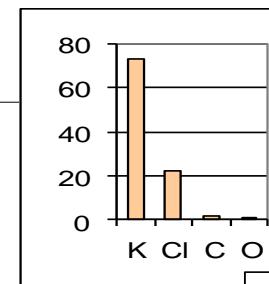
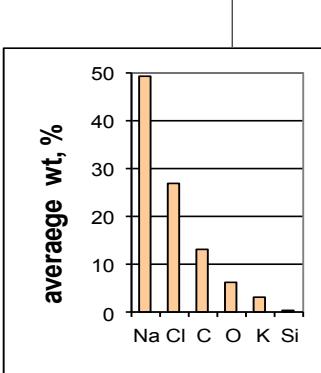
K-rich
28,8%

Organic
14,8%

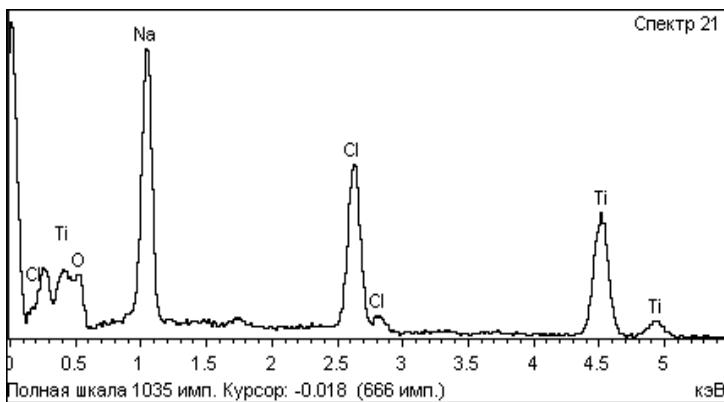
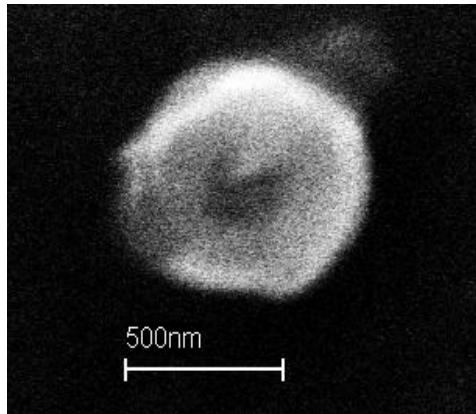
Al,Si-rich
3,0%

Ca-rich
6,4%

Fe-rich
14,4%



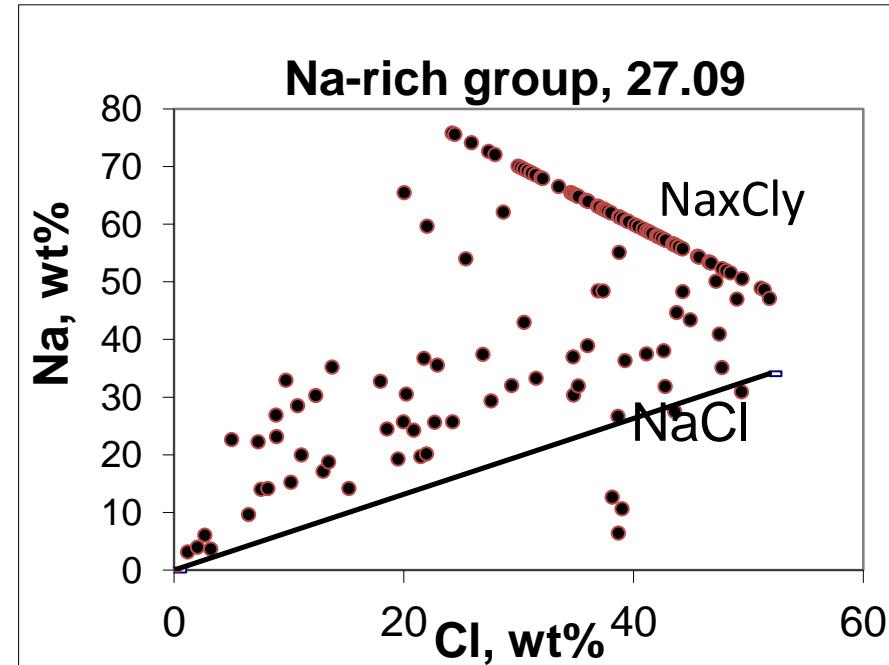
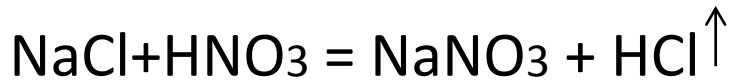
Group Na – rich, 32.5% reacted sea salt



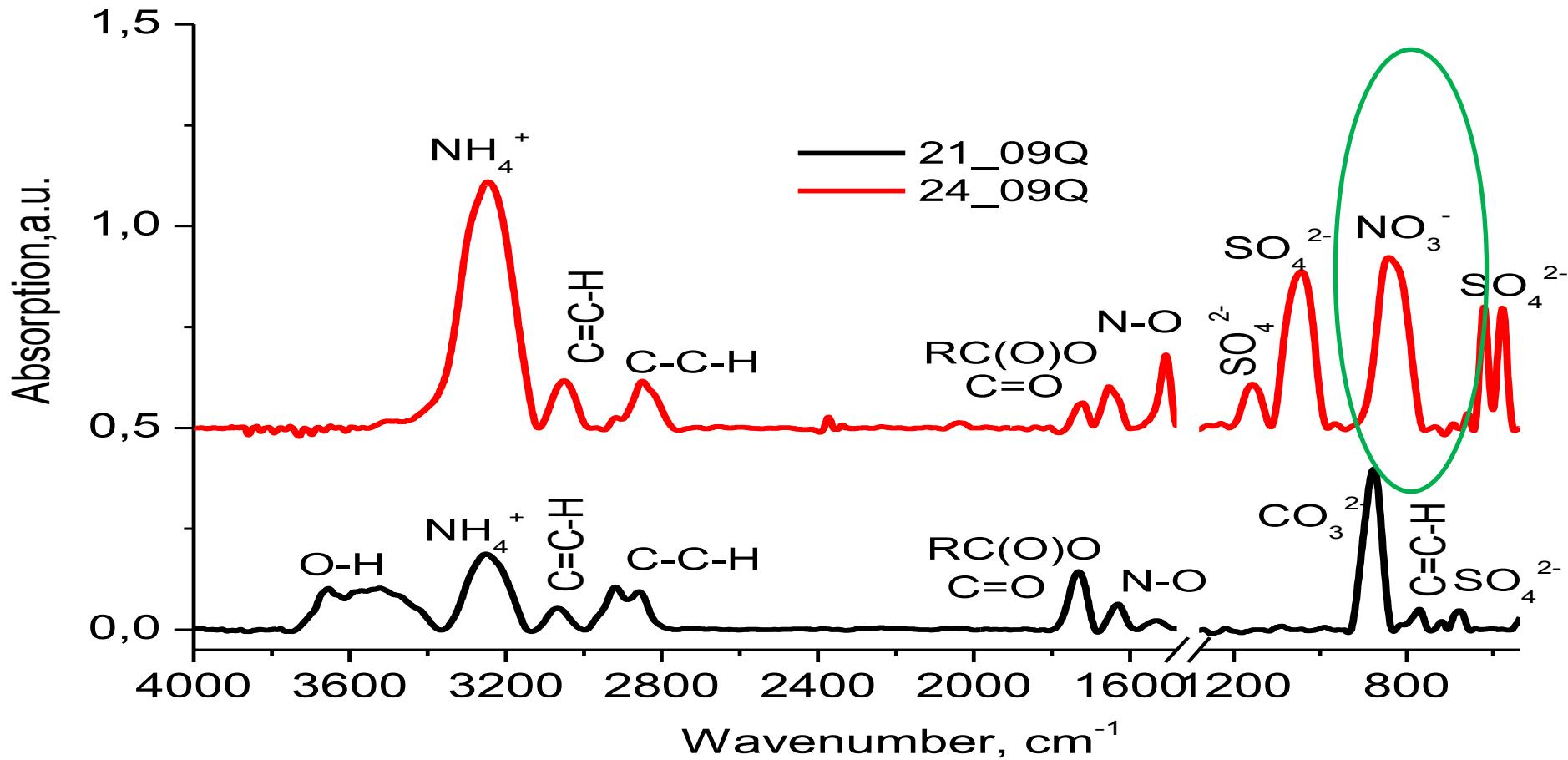
10%- Na
40% - Na,Cl
29% -C,O, Na,Cl
21% - Na,Cl,K

Depletion Cl in Arctic environment

Complete reactions with HNO₃ and NO_x



21-24 September 2014, aerosol composition of natural background, FTIR

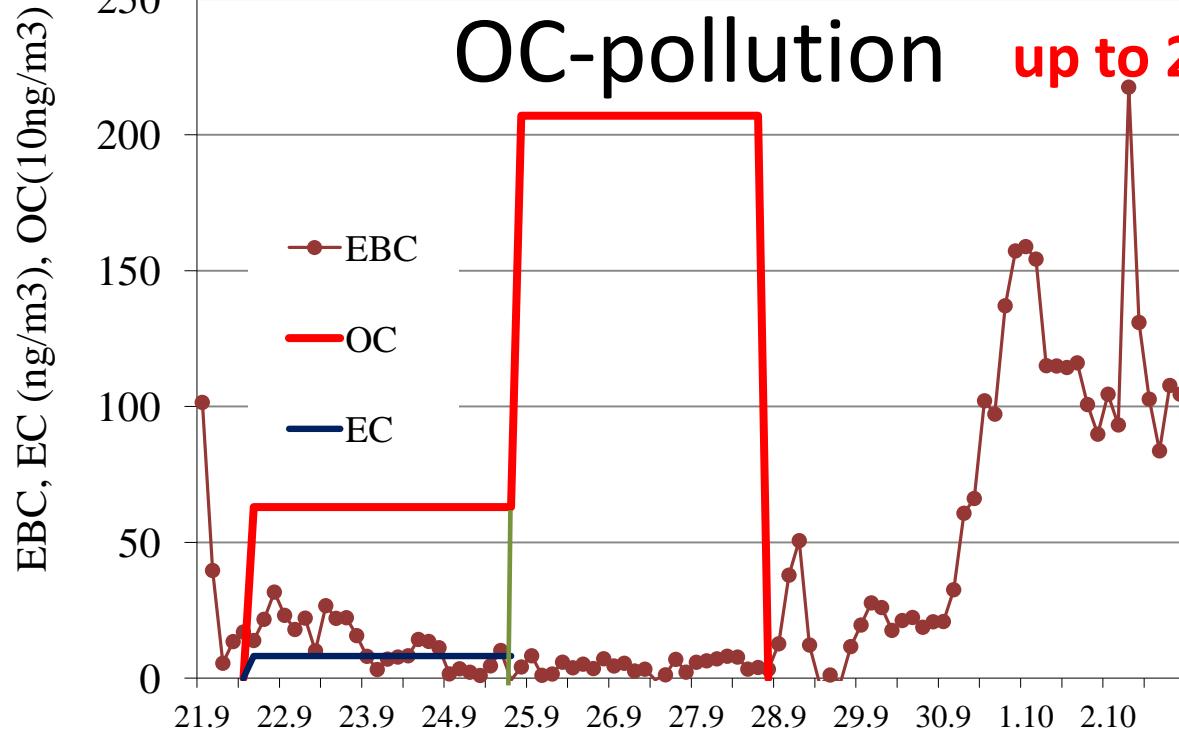


Nitrates NO₃⁻ lead to depletion of Cl

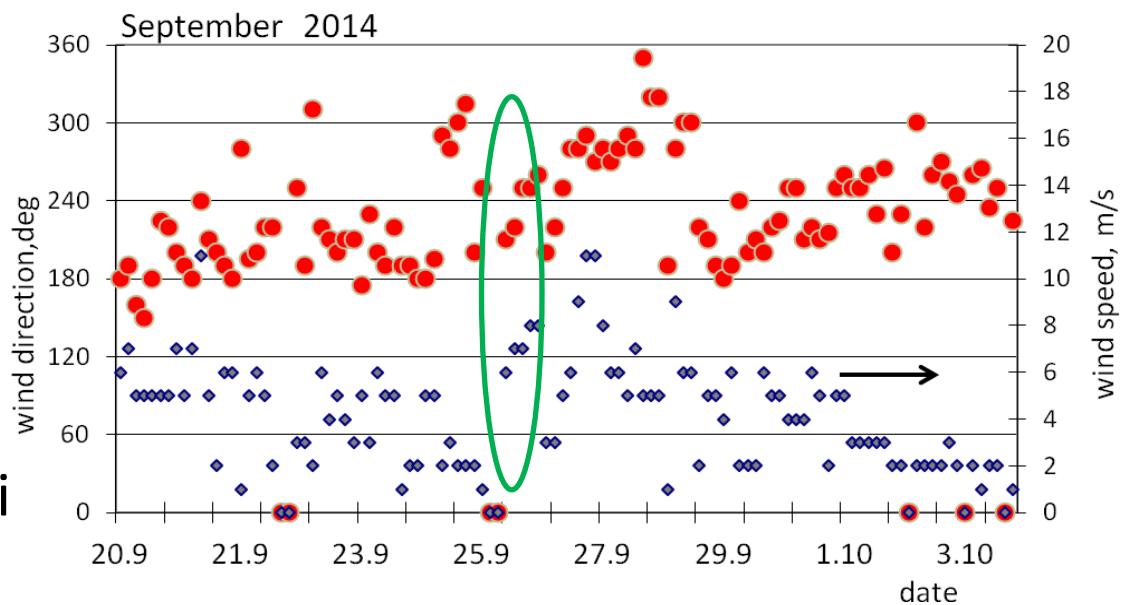
Rich organic and N-functionalities of biogenic origin

Sulfates SO₄²⁻ in sulfuric acid and salts , ammonium NH₄⁺

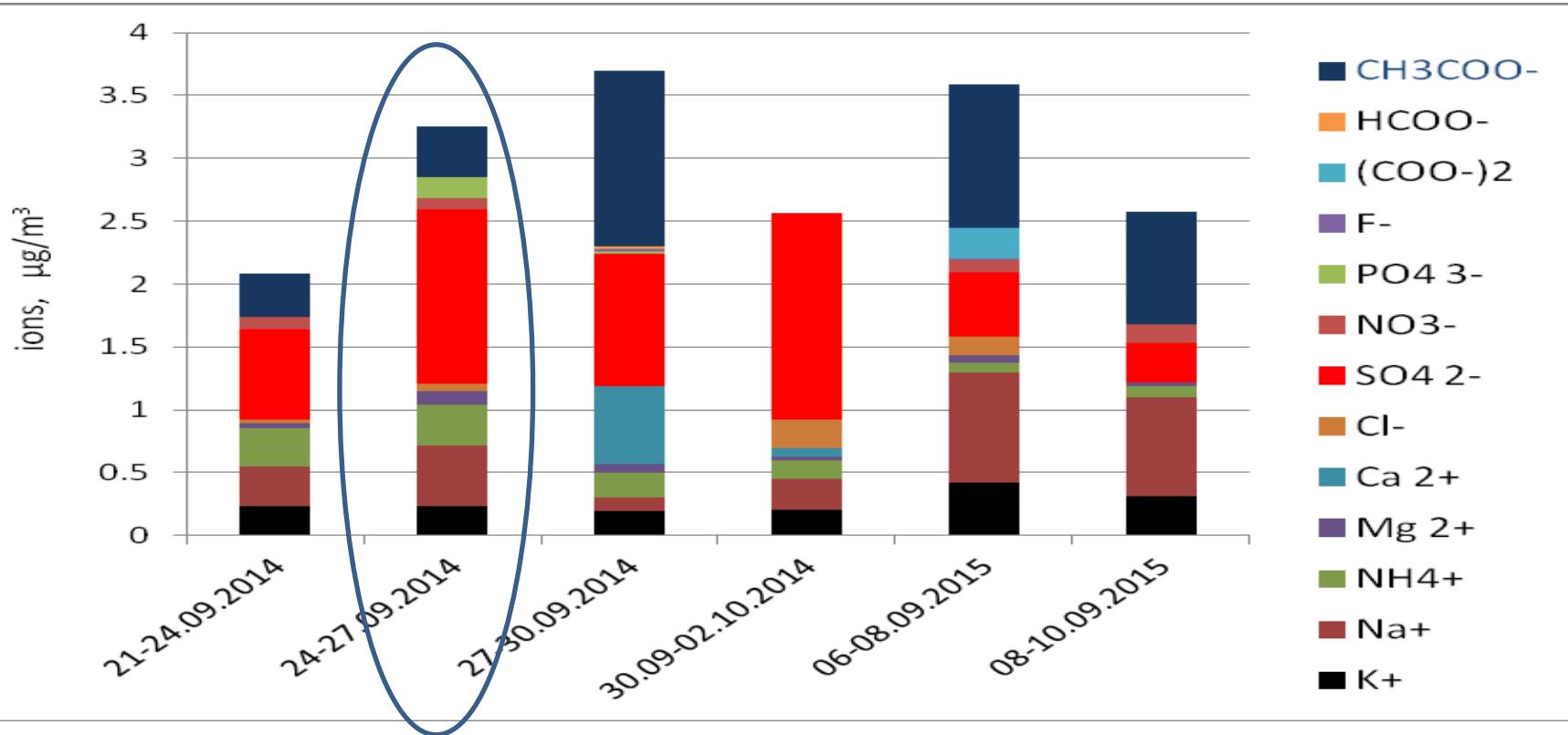
25-28 September 2014



Weak wind,
north direction from Tiksi



Source of OC pollution?



High nss- sulfates, CH_3COO^- ,
Nss- K^+
 PO_4^{2-} - tracers of waster burning

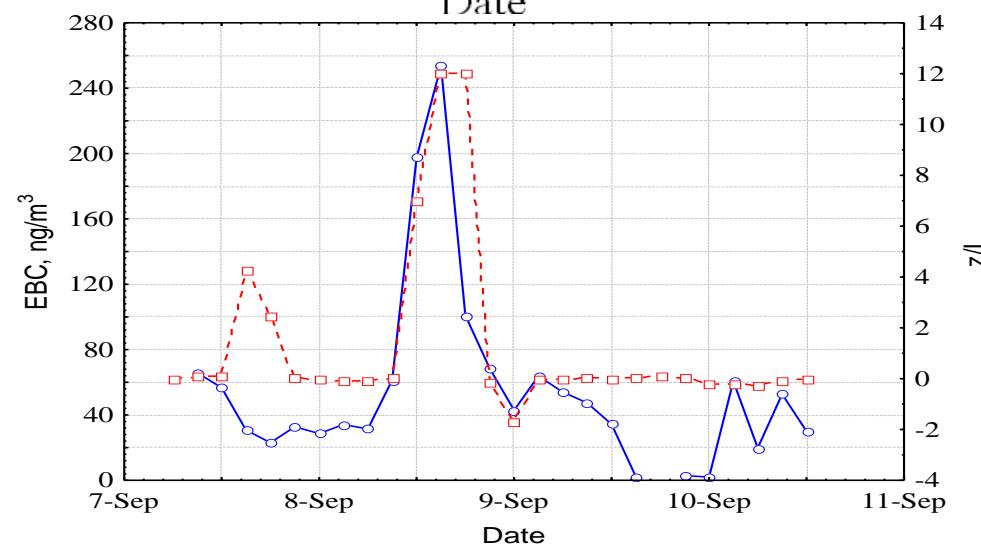
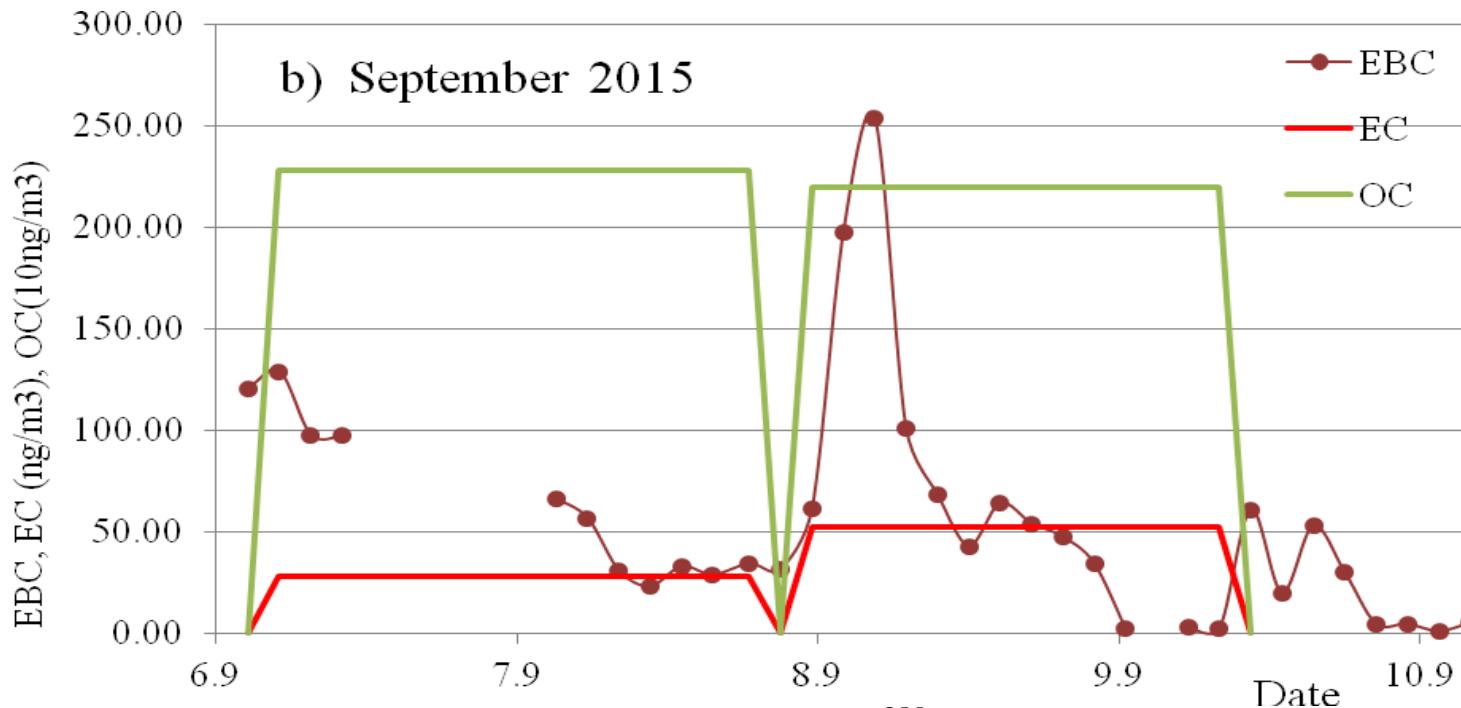
Landfill disposal site in Tiksi



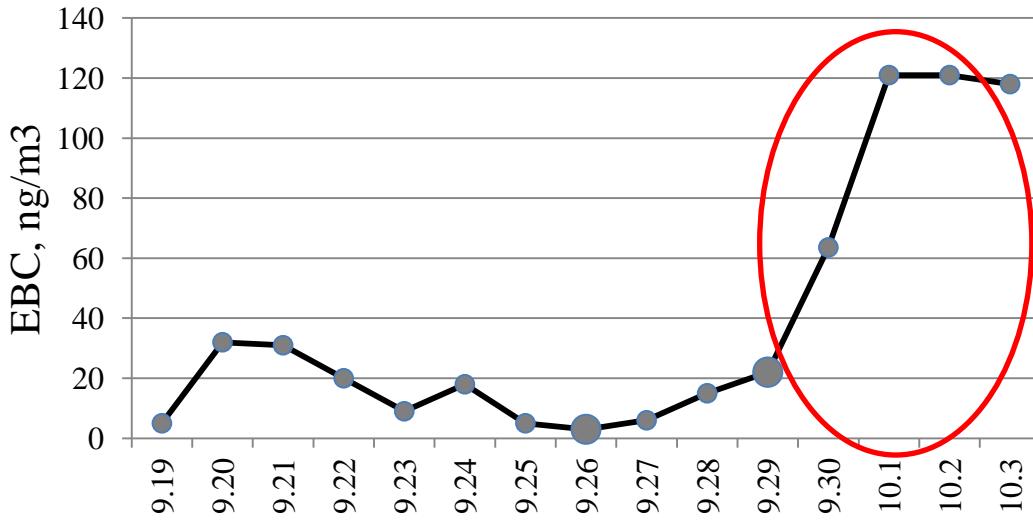
<http://www.bulun.ru/588-2014-09-20-12-43-34.html>

September 2015

OC-pollution



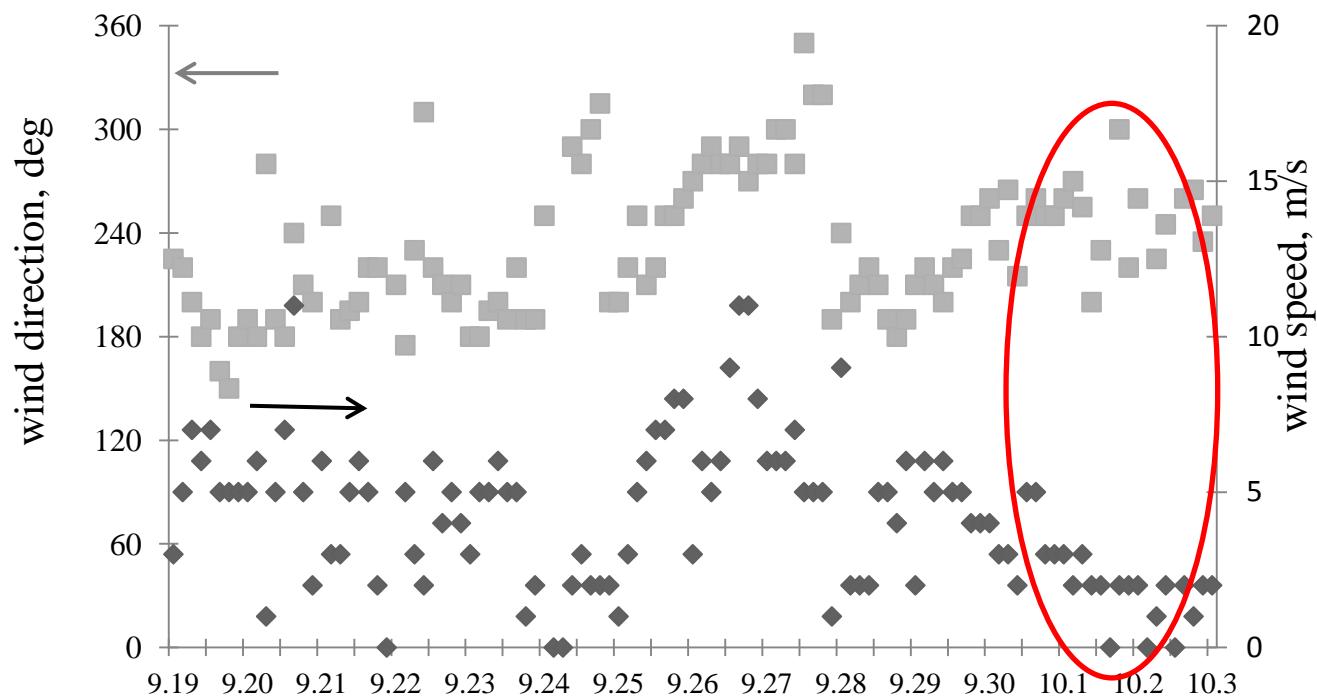
Suddenly , BC pollution episode since 30 Sep 2014



increases 6 times EBC

low <2 m/s
wind speed

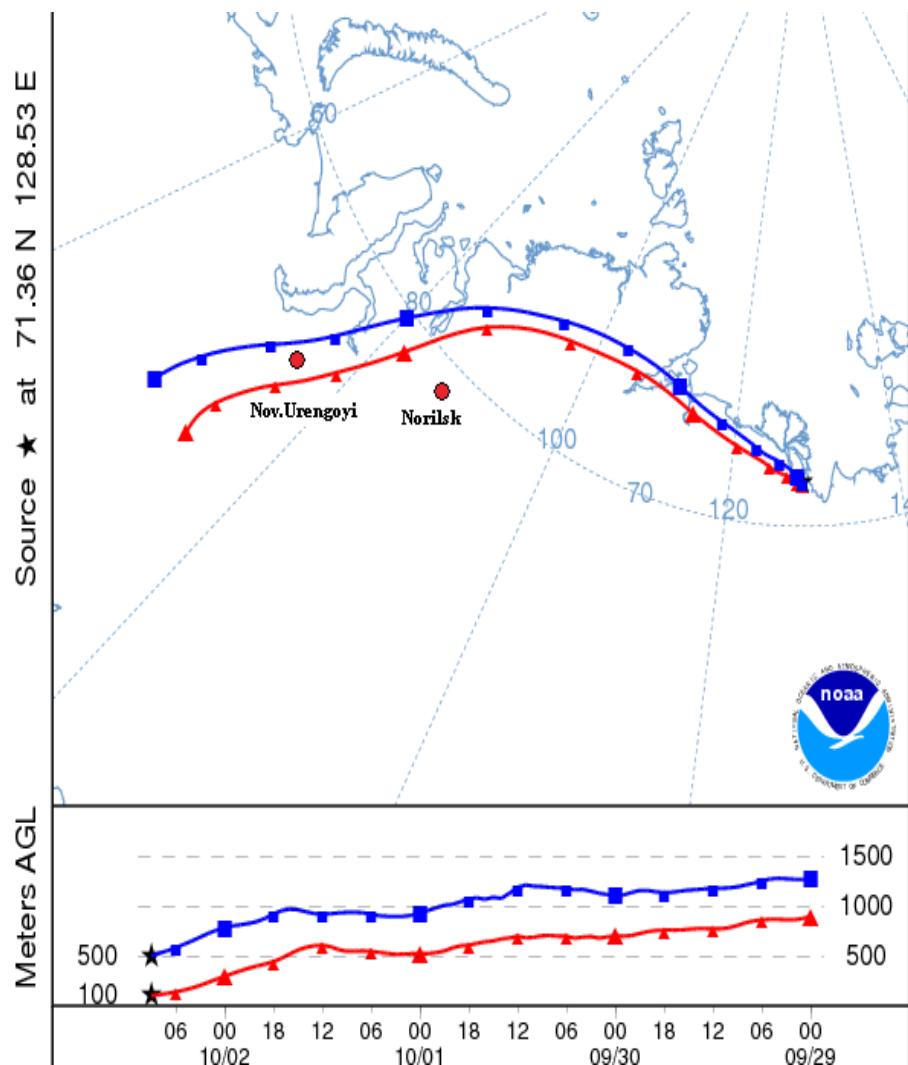
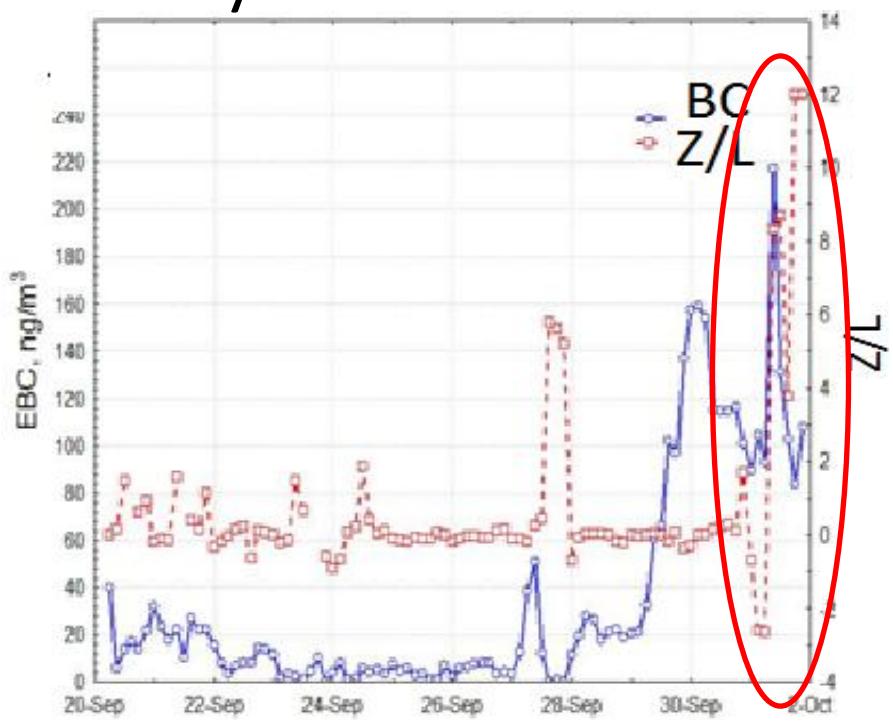
South-west wind

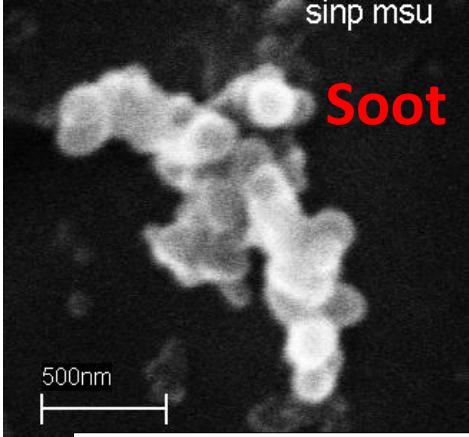


In days of BC pollution episode

29 September - from Norilsk industrial ar

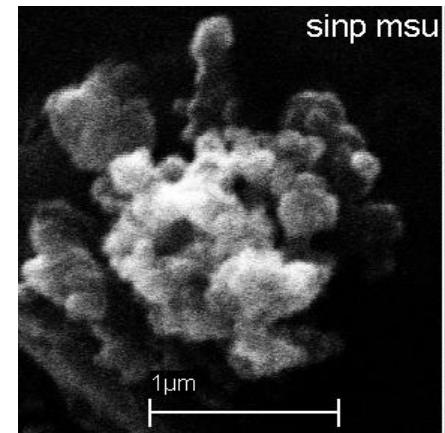
Steady stratification



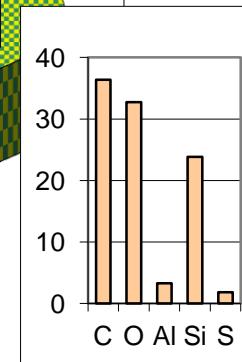
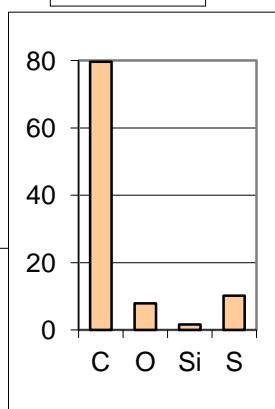
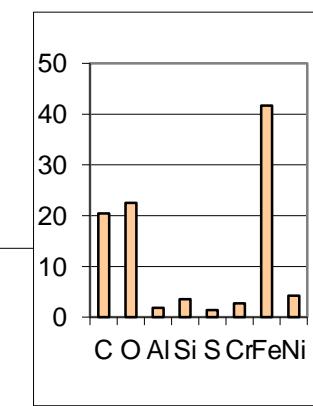
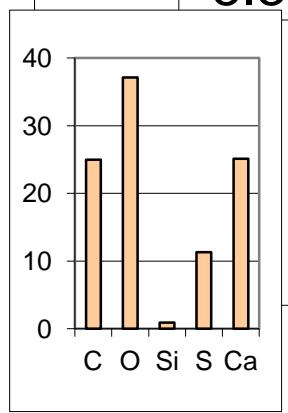
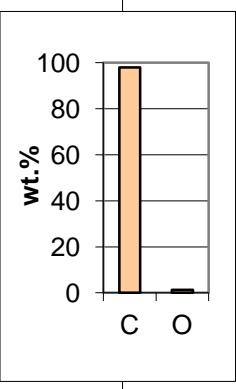
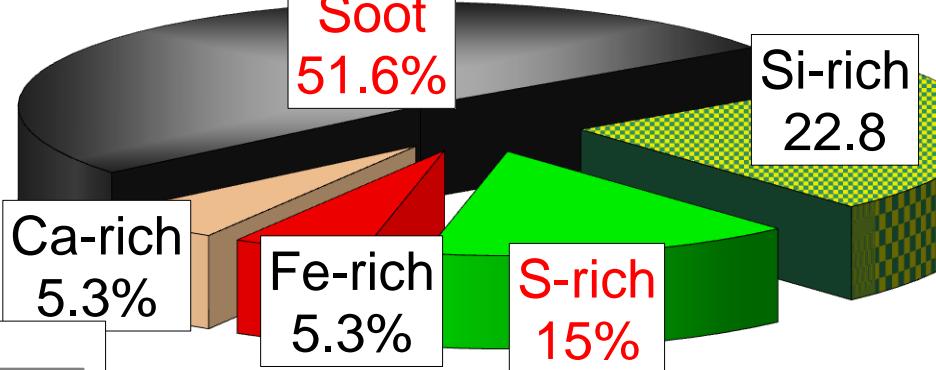


Polluted environment

30 September 2014



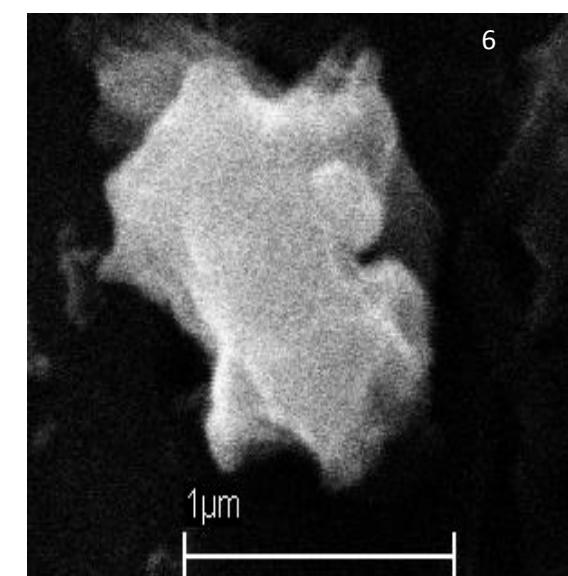
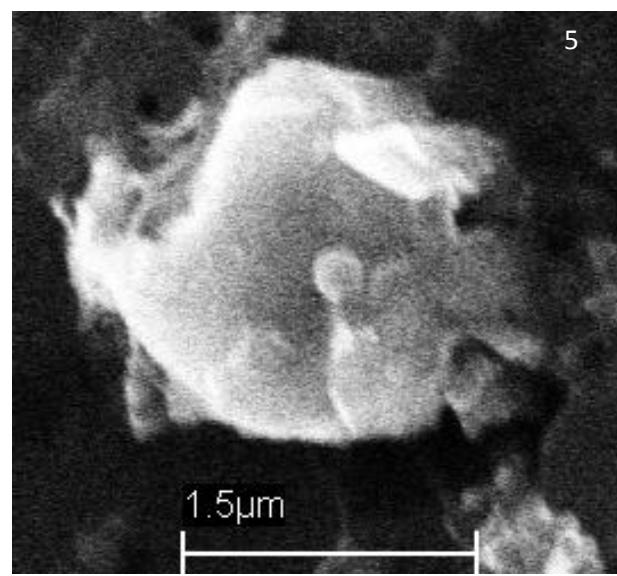
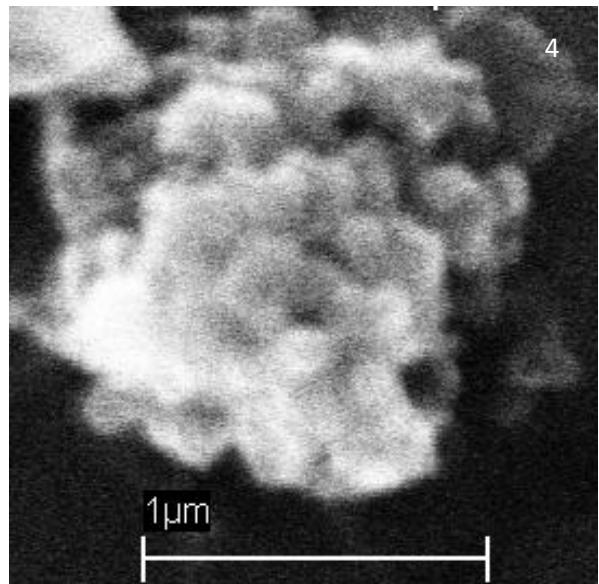
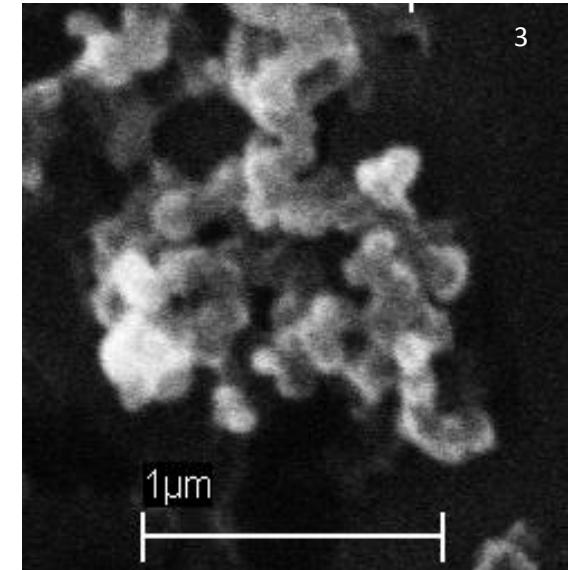
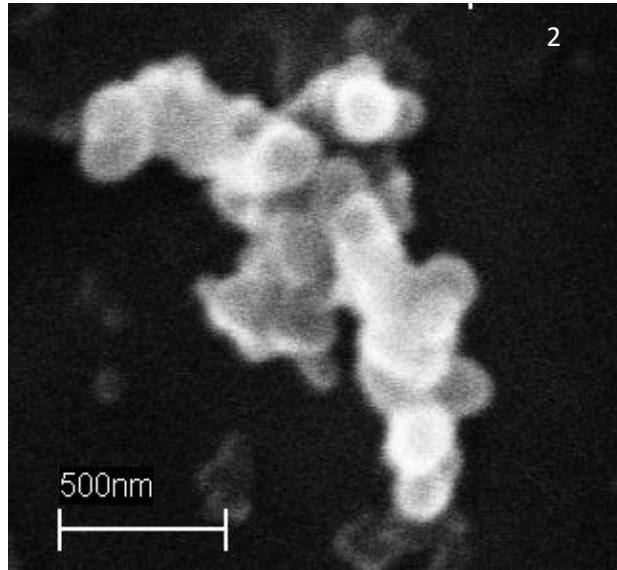
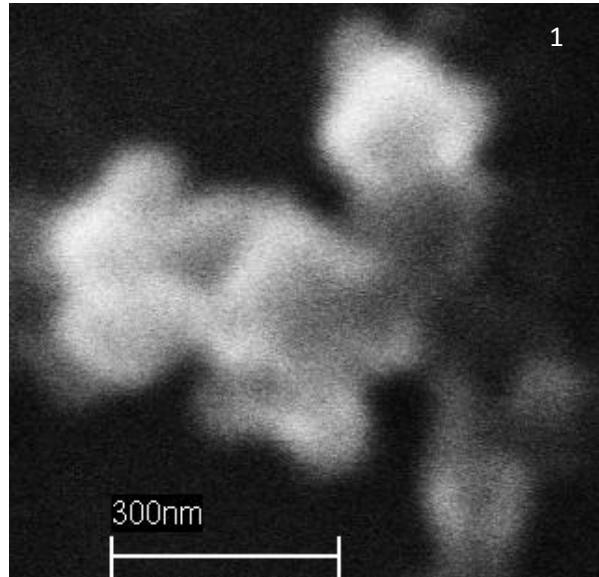
Aerosol grouping



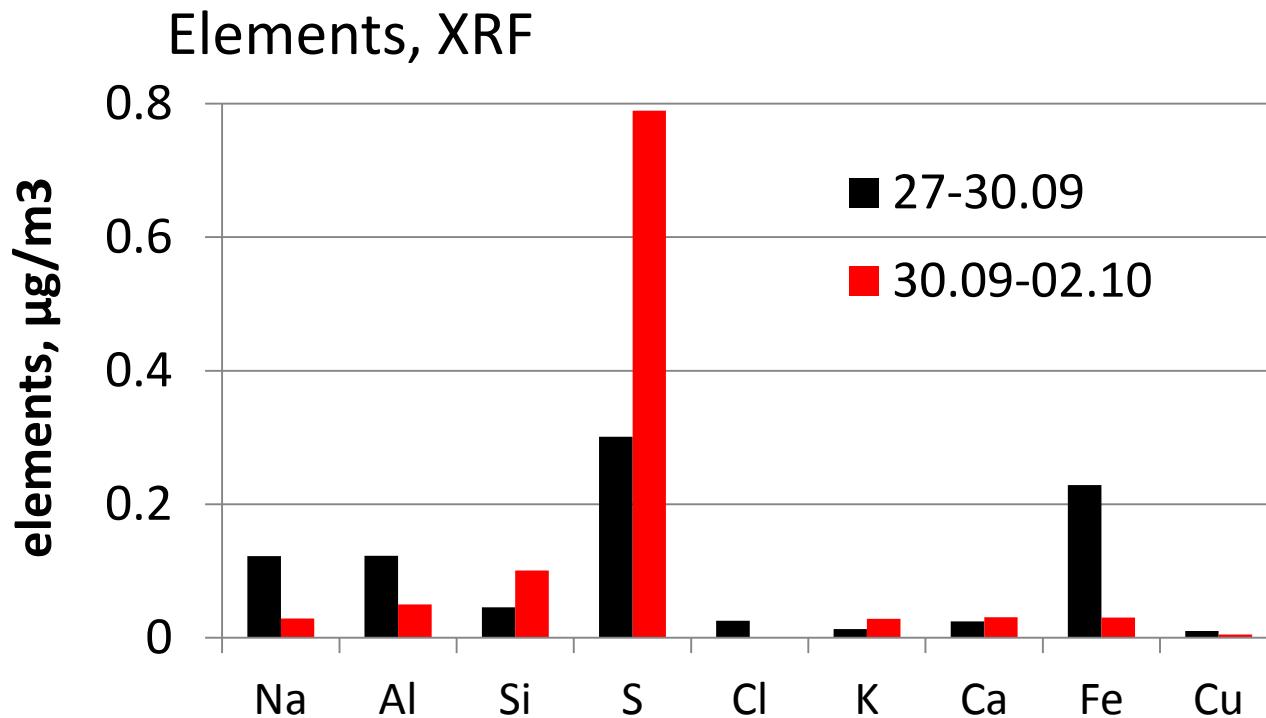
In polluted days of high BC:

- 3.5 times increase of Soot Group
- appearance of Group S-rich

Soot pollution event on Tiksi 30 September 2014



Polluted AEROSOL since 30 Sep 2014

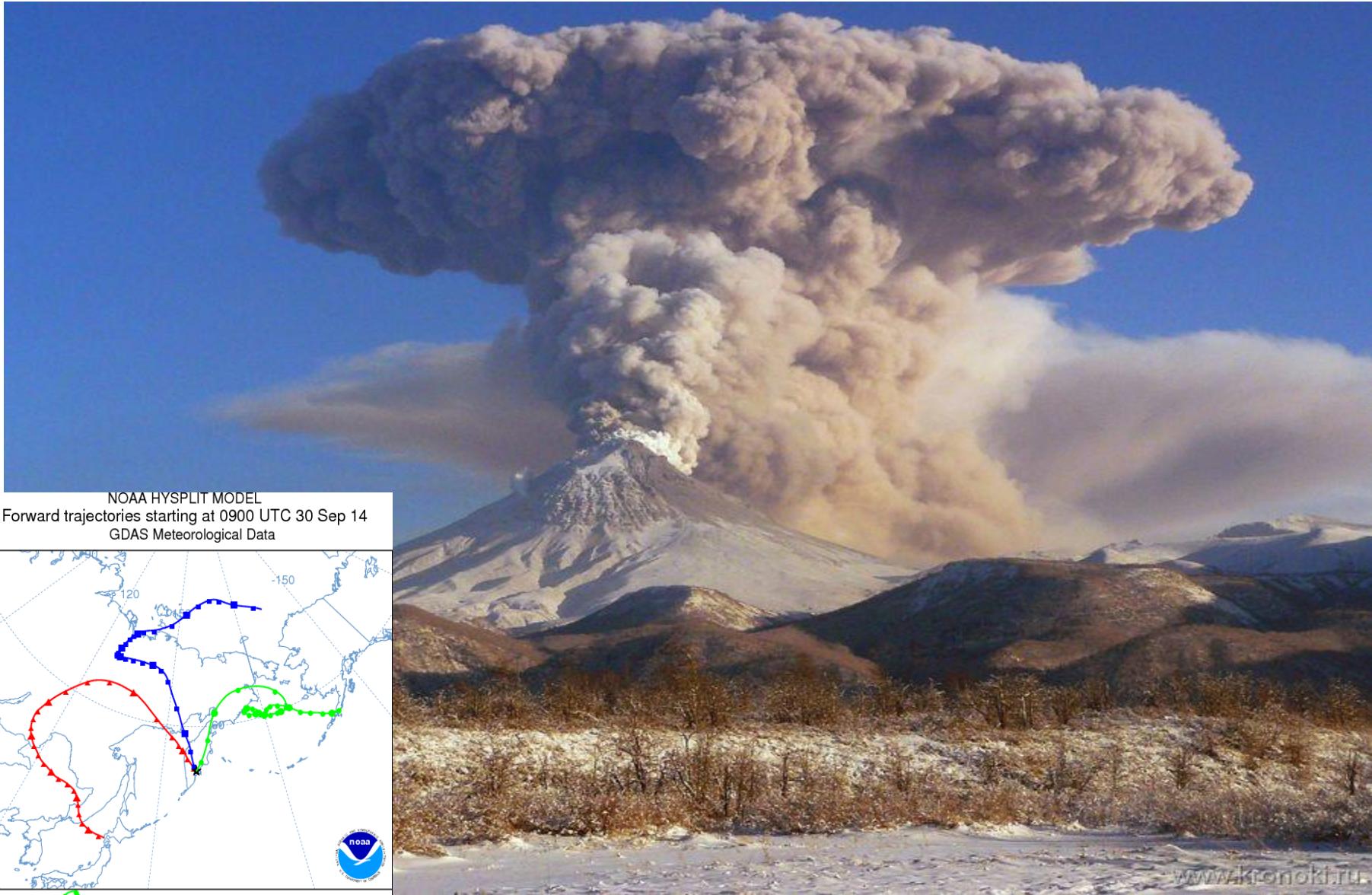


Pollution event

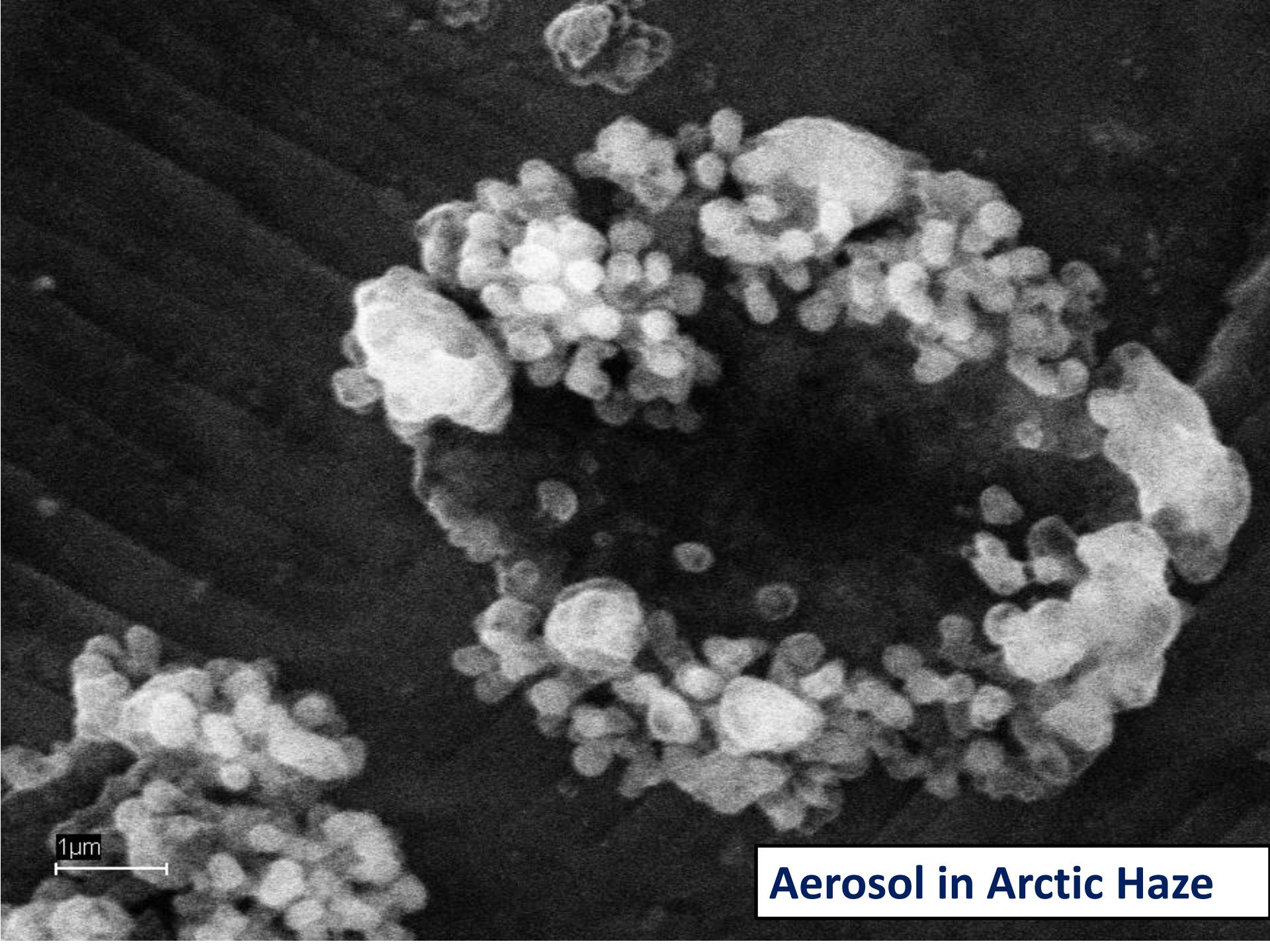
- increases **sulfur 3 times**
- decreases Na and Fe of natural sources

Tiksi – typical arctic city





24 September 2014 - volcano Shiveluch eruption on Kamchatka

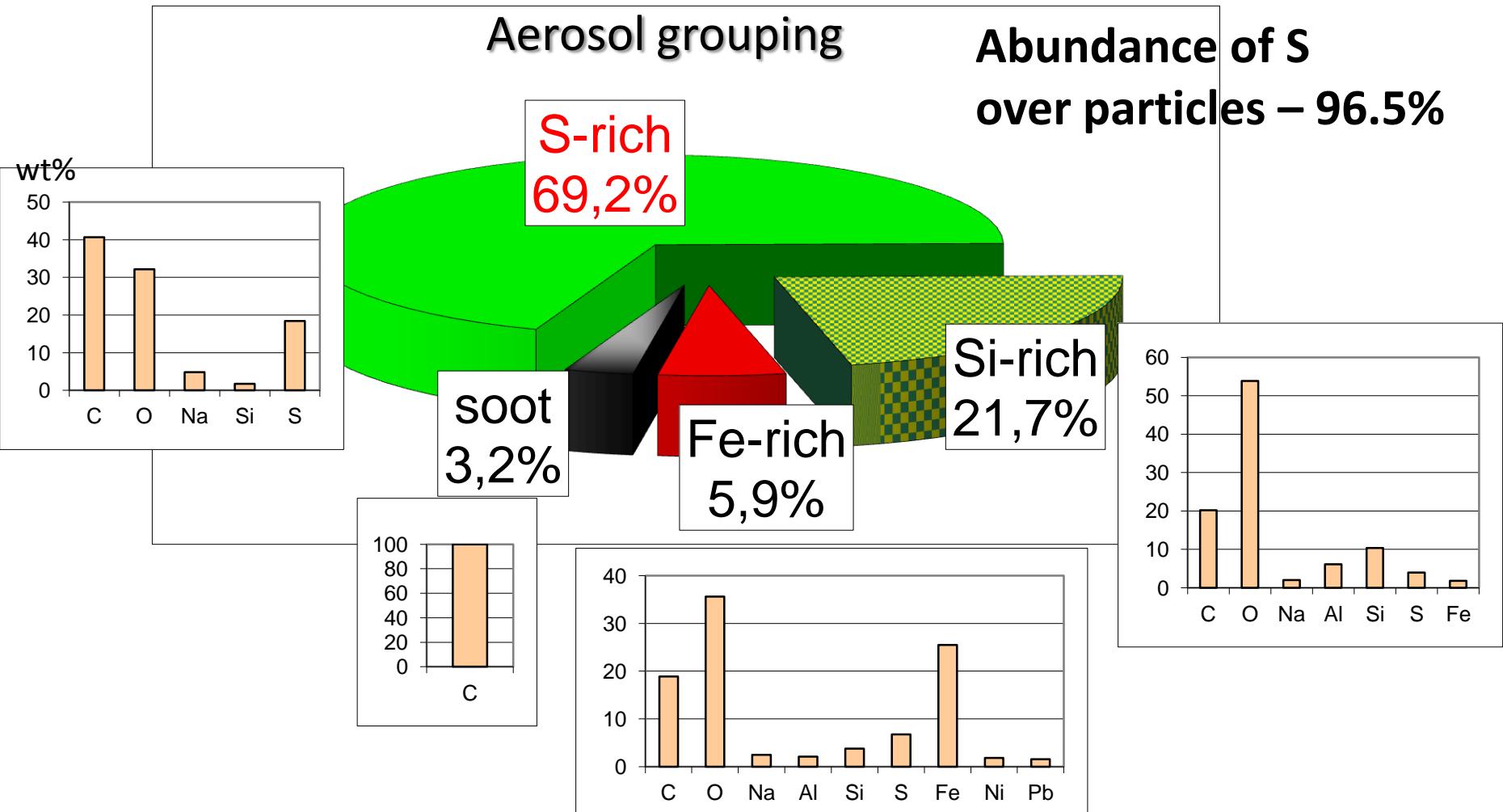


1 μ m

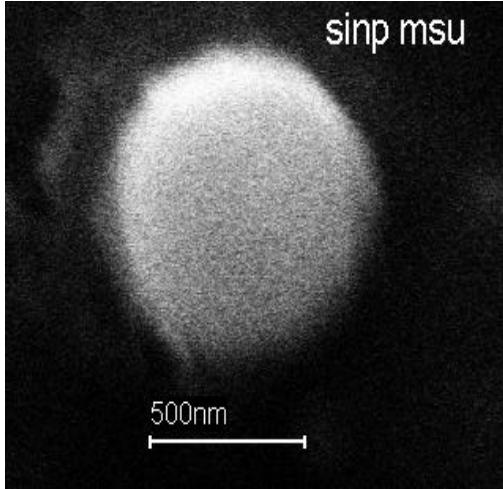
Aerosol in Arctic Haze



22 November 2014
-22C, wind direction west

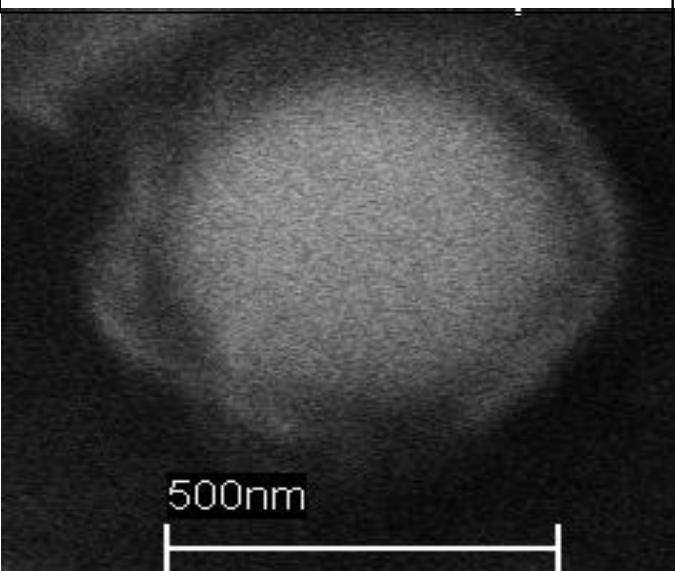


Sulfates – dominated winter aerosols

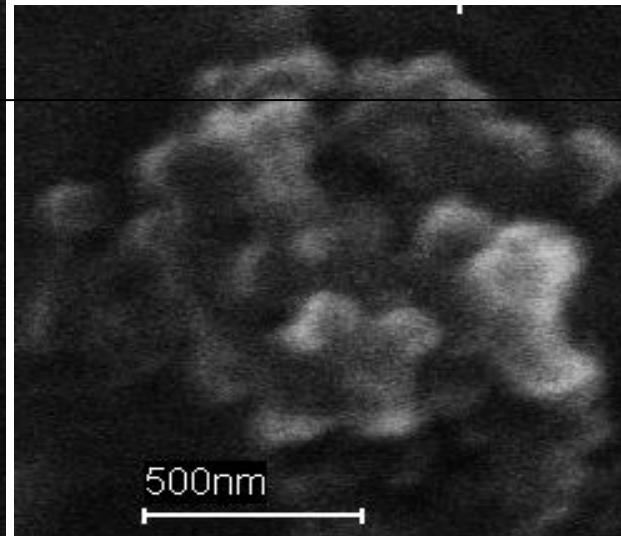


Sulfate aerosol

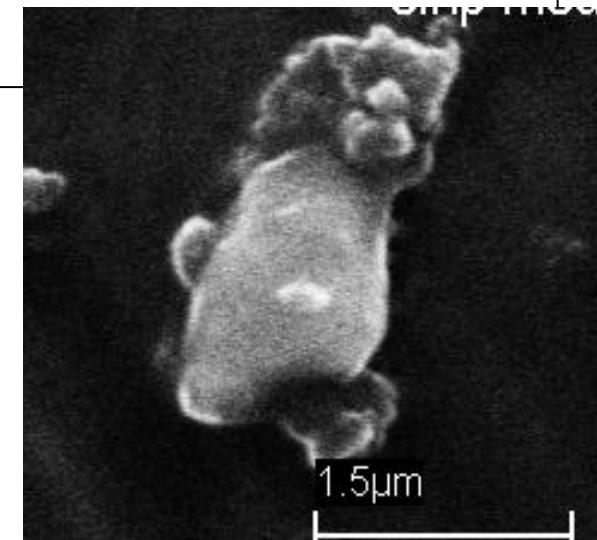
Na_2SO_4 condensed
on organic aerosol



Na_2SO_4 condensed on
Soot



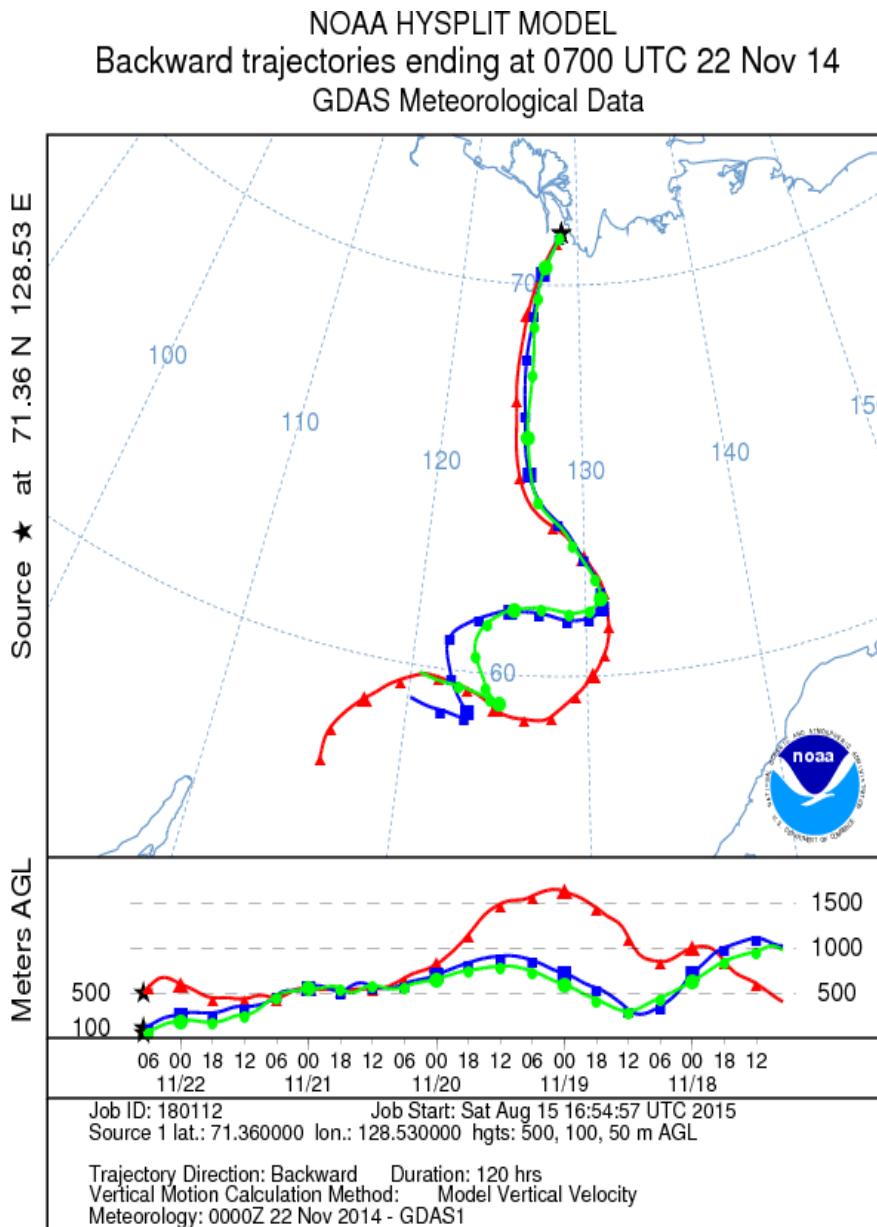
Aluminosilicates



5 days air trajectories arrive from south, from Siberia

22 November 2014

Long-term transport
from lower latitudes



Aerosol on Tiksi:

- **Autumn aerosol** in natural background is dominated by reacted sea salts in nitrogen oxide - polluted atmosphere and by biogenic emissions.

Autumn is time of local emission impact.

- **Pollution episode** relates to **anthropogeneous emission of BC and sulfates**, and depression of marine and biogenic compounds.
- **Winter aerosol** demonstrates the prominent features **of sulfate - dominated aging** due to **long transportation from continent**
- EC and EBC is following the season variations
high concentrations of OC and sulfates are most prominent .

Sources of pollution of Russian Arctic are prominent